MODEL V-1065A/V-665A/V-1060/V-660

OSCILLOSCOPE

OPERATION MANUAL

WARNING

TO AVOID ELECTRIC SHOCK , DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

IMPORTANT

READ RULE FOR SAFE INSTALLATION, OPERATION AND INSTRUCTION CAREFULLY.

RETAIN THIS MANUAL FOR FUTURE REFERENCE.

Hitachi Denshi, Ltd.

WARRANTY

This Hitachi Denshi, Ltd. product is warranted against defects in workmanship and materials. If any failure, resulting from a defect in either workmanship or material shall occur under normal use within **THREE YEARS** from the original date of purchase, such failure shall be corrected free of charge to the original purchaser by repair or, at Hitachi Denshi's sole option, replacement of the defective part or parts. No charge shall be made for labor or services performed during said **THREE YEARS** period providing the defective product is brought or sent prepaid to our Authorized Service Station. Hitachi Denshi, Ltd. will either repair or at its sole option, replace any part except for fuses, probes, lamps, batteries and other optional materials which are defective in either workmanship or material under normal and proper use.

DISCLAIMER

This warranty does not cover equipment which has been tampered with in any way, or to damage caused by accident, negligence, alteration, or misapplication.
This product must be returned transportation prepaid, properly packed and insured. Hitachi Denshi, Ltd. bears transportation cost of the repaired product back to the purchaser. This warranty applies only to the original purchaser.

NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED. HITACHI DENSHI, LTD. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

—— NOTE FOR USERS IN THE UNITED STATES OF AMERICA ——

NOTE FOR A OPERATION

This apparatus has been designed and tested in accordance with UL 1244, Electrical and Electronic Measuring and Testing Equipment, and has been supplied in a safe condition.

—— NOTE FOR USERS IN CANADA ——

NOTE FOR A OPERATION

This apparatus has been designed and tested in accordance with CSA 22.2 No.1, Electronic Development and Test Equipment, and has been supplied in a safe condition.

—— NOTE FOR USERS IN EUROPE ARIE ——

NOTE FOR A OPERATION

This apparatus has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, Safety class Ⅰ, and has been supplied in a safe condition. The insulation condition between the secondaly accessible terminal and the power supply conform to safety class Ⅱ.

—— NOTE FOR USERS IN GERMANY ——

HINWEISE FÜR SIEHEREN BETRIEB

Dieses Gerät ist gemäß DIN 57411 Teil 1 / VDE 0411 Teil 1, Schutzmaßnahmen für elektronische Meßgeräte, Geräten der Schutzklassen Ⅰ, gebaut, geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen.
Die Isolierung zwischen den zugänglichen Sekundärklemmen und dem Netzteil entspricht der Schutzklemme Ⅱ.

NOTES FOR A SAFETY OPERATION

○ The present operation manual contains some informations and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

○ The apparatus has been designed for indoor use. It may occasionally be subjected to temperatures between +5℃ and –10℃ without degradation of its safety.

○ Before switching on the apparatus, make sure that it is set to the voltage of the power supply.

○ The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

○ The mains plug shall be inserted before connections are made to measuring or control circuits.

Warning !

○ Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

○ When the apparatus is connected to its supply, terminals may be live, and the opening of covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

○ Never touch the CRT anode terminal inside the instrument charges of approx. 15kV are retained, and they be dangerous to life.

○ Capacitors inside the apparatus may still be charged even if the apparatus has been disconnected from all voltage sources.

○ Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by our authorized service person who is aware of the hazard involved.

○ Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short- circuiting of fuse holders are prohibited.

○ Whenever it is likely that the protection has been impaired, the apparatus must be powered off and be secured against any unintended operation.

○ The protection is likely to be impaired if, for example, the apparatus :

–shows visible damage,

–fails to perform the intended measurements,

–has been subjected to prolonged storage under unfavourable conditions,

–has been subjected to severe transport stresses.

○ Do not use and storage the instrument in an extremely hot or cold place.

–The operating ambient temperature is between 0°C and + 50°C.

–The storaging ambient temperature is between –20°C and + 70°C.

○ Do not use and storage the instrument in an extremely wet or dry place.

–The operating ambient humidity is between 35% and 85%.

–The storaging ambient humidity is between 45% and 85%.

○ Do not apply a heavy shock to the instrument.

–The shock limit : Free fall from height of 80cm or less in condition packaged by Hitachi original way.

Hinweise für sicheren Betrieb

○ Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muß der Anwender die Hinweise und Warnvermerke beachten, die in dieser Gebrauchsanweisung enthalten sind.

○ Vor dem Einschalten ist sicherzustellen, daß die am Gerät eingestellte Betriebsspannung und die Netzspannung übereinstimmen.

○ Der Netzstecker darf nur in eine Steckdose mit Schutzkontakt eingeführt werden.
Die Schutzwirkung darf nicht durch eine Verlängerungsleitung ohne Schutzleiter aufgehoben werden.

○ Der Netzstecker muß eingeführt sein, bevor die Meß-und Steuerstromkreise angeschlossen werden.

WARNUNG !

○ Jegliche Unterbrechung des Schutzleiters innerhalb oder außerhalb des Gerätes oder Lösen des Schutzleiteranschlusses kann dazu führen, daß das Arbeiten mit dem Gerät eine Gefahr für den Benutzer darstellt.
Absichtliche Unterbrechung das Schutzleiters ist nicht zulässig.

○ Beim Öffnen von Abdeckungen oder Entfernen von Teilen, außer wenn dies von Hand möglich ist, können spannungsführende Teile freigelegt werden.
Anschßstellen können auch spannungsführend sein.
Vor einem Abgleich, einer Wartung, einer Instandsetzung oder einem Austausch von Teilen muß das Gerät von der Spannungsversorgung getrennt werden, wenn ein Öffnen des Gerätes erforderlich ist.
Wenn danach ein Abgleich, eine Wartung oder eine Reparatur am geöffneten

Gerät unter Spannung unvermeidlich ist, so darf das nur durch eine Fachkraft geschehen, die mit den damit verbundenen Gefahren vertraut ist.

- Die Anodenklemme der Bildröhre darf bei einem spannungsführendem Gerät wegen Hochspannungen bis 15kv niemals berührt werden, da ansonsten Lebensgefahr besteht.

- Kondensatoren im Gerät können noch geladen sein, selbst wenn das Gerät von allen Spannungsversorgungen getrennt wurde.

- Es ist sicherzustellen, daß nur Sicherungen vom angegebenen Typ und der angegebenen Nennstromstärke als Ersatz verwendet werden. Die Verwendung geflickter Sicherungen oder das Kurzschließen des Sicherungshalters ist unzulässig.

- Wenn anzunehmen ist, daß ein gefahrloser Betrieb nicht mehr möglich ist, so ist das Gerät außer Betrieb zu setzen und gegen unerlaubten Betrieb zu sichern.

- Es ist anzunehmen, daß ein gefahrloser Betrieb nicht mehr möglich ist,
  - –wenn das Gerät sichtbare Beschädigungen aufweist,
  - –wenn das Gerät nicht mehr arbeitet,
  - –nach längerer Lagerung unter ungünstigen Verhältnissen,
  - –nach schweren Transportbeanspruchungen.

- Lagern und benutzen Sie das Gerät nie bei extremen Temperaturen.
  - –Der Arbeitstemperaturbereich liegt zwischen 0°C und +40°C.
  - –Der Temperaturbereich zur Lagerung des Gerätes liegt zwischen –20°C bis +70°C.

○ Lagern und benutzen Sie das Gerät nie bei extremer Luftfeuchtigkeit.
  -Der Arbeitsluftfeuchtigkeitsbereich liegt zwischen 35% und 85%.
  -Der Luftfeuchtigkeitsbereich zur Lagerung des Gerätes liegt zwischen 45% und 85%.

○ Setzen Sie das Gerät keiner starken Erschütterung oder Stößen aus.
  -Erschütterungsgrenze : Freier Fall von maximal 80cm Höhe, wenn das Gerät in Originalverpackung von HITACHI ist.

NOTES FOR A SAFETY OPERATION

Before operating the oscilloscope, be sure to check the following items.

(1) Terms in this manual

WARNING: Indicates a possible injury to a body or danger to life if care is not taken as described.

CAUTION: Indicates possible damage to the oscilloscope or other equipment if care is not taken as described.

(2) Symbols

DANGER: Indicates the part which may cause an injury to a body or danger to life.

DANGER: Indicates the high voltage part in the oscilloscope.

CAUTION: Indicates to read the applicable items in this manual.

: Protective earth terminal

(3) Notes for operation

① Connection with the AC power source

The oscilloscope is provided with the protective earth terminal and the three-line power cord and plug to be connected to the AC power source. The lead of the protective earth terminal is connected to the metalic part of the oscilloscope.

Be sure to plug the power cord into an AC outlet provided with a protective earth terminal to avoid the risk of electric shock.

② Replacement of fuse

Use only specified fuses.

The instrument is protected by a 2 A fuse on the primary side of the power supply.

When this fuse blows, contact your nearest Hitachi Denshi representative. Do not try to use any fuse other than the specified ones.

Otherwise, further damage may occur and this could be dangerous.

(IMPORTANT: Use only the fuse of same size and rating as specified.)

Line voltage	Capacity	Diameter × Length	Type
100V AC 120V AC	2A	mm mm 5.2 × 20 (0.2" × 0.8")	MT4-2A 250V UL . CSA
220V AC 240V AC	1A		EAK-2A 250V

③ Operation in gas

Do not use the oscilloscope in combustible gas or vapor to avoid possible explosion.

④ POWER switch

Before plugging in the AC cord, be sure to check that the POWER switch is set to OFF for protection of the equipment.

⑤ Removal of the chassis

To avoid the risk of electric shock, do not remove the chassis by yourself. Contact your nearest Hitachi Denshi representative.

NOTE

- The oscilloscope operates normally with the 90 to 250 V line voltage. If the line voltage is out of the above range (especially low voltage), the normal operation may not be restored even after the correct line voltage is applied. Use the oscilloscope within the specified line voltage. If an abnormal operation occurs, check the line voltage, turn off the power for a short time, and then turn it back on.

WARNING:
Do not remove the chassis cover since a high voltage presents inside the equipment. When parts inside the equipment need to be adjusted or replaced, contact your nearest Hitachi Denshi representative.

- When the power is turned on, the built-in microprocessor automatically calibrates the time base and diagnoses the sweep circuit operation. After the calibration, the time base settings are initialized.
  The displays "CALIBRATION" and "COMPLETED" appear to show the normal calibration and sweep circuit operation. If other displays such as "CALIBRATION FAILED AT CYCLE CKT" appear and the display remains even when the power is turned off and on, contact your nearest Hitachi Denshi representative.

NOTES:
- It will take twenty seconds approx. until the automatic calibration and diagnosis are completed after the power is turned on.
- When the power switch is turned on after storage at a low temperature, it takes some time before the circuit operation becomes stable.

If a failure display appears while the power is on, keep the power-on state for several minutes. Turn off the power, then turn it back on, and check that the "COMPLETED" display appears.

- The built-in microprocessor may misoperate when turning the power switch on/off rapidly. Avoid rapid toggling of the power switch and allow three seconds or more for toggling.

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1. FEATURES

The Hitachi portable read-out oscilloscope provides measurement reliability and ease of operation by employing a microprocessor.
The major features are:

(1) Measurement information display

The measurement information including the sweep speed, the delay time, the UNCAL display, and the voltage sensitivity of the vertical axis (V-1065A, V-665A only) is alphanumerically displayed on the CRT.

Since troublesome setting operation procedures are eliminated, an operator can concentrate on the displayed data for measurement.

(2) Measurement value display (V-1065A, V-665A only)

The distance between the two cursors displayed can read out the following;

- Δ V : Voltage between the reference cursor and the delta cursor
- Δ T : Time between the reference cursor and the delta cursor
- 1/Δ T: Reciprocal of the time

The displayed data eliminates troublesome and time consuming calculation procedures. Moreover, miscalculation of the scales is completely avoided.

(3) Automatic time base range setting

At a press of the AUTO button, an optimum time base range is automatically set. (A signal period from 1.6 to 4 cycles approx. is displayed.)
The time base range is automatically changed to a corresponding change in input signal period.

(4) Trigger lock

Since complicated pulse train waveforms are hard to trigger on, performing the trigger lock function enables sweep independent triggering. The "sweep time plus holdoff time" is fixed and a stable trigger is obtained at any time range.

(5) Bandwidth

V-1065A: DC-100 MHz from 5 V/div to 5 mV/div
V-1060 DC-20 MHz at 2 mV/div
V-665A: DC-60 MHz from 5 V/div to 5 mV/div
V-660 DC-10 MHz at 2 mV/div

(6) High sensitivity

High sensitivity of 2 mV/div is provided.

(7) Internal graticule

Internal graticule lines eliminate parallax-viewing error between the trace and the graticule lines.

(8) Delayed sweep

With delayed sweep, a portion of the signal can be magnified for more accurate measurement and time comparison. The delay time is digitally displayed and the window of delayed sweep (B) is indicated on the main sweep (A) with cursors.

(9) Auto trigger level

Auto measuring of trigger level is employed, so that trigger level range is matched to the trigger signal for maximum trigger sensitivity and stability.

(10) TV triggering

Exclusive TV sync separator circuit technology provides stable TV signal measurements on fields, frames and lines.

2. ACCESSORIES

The oscilloscope is shipped with the following standard accessories:

2 Probes (AT-10AS1.5)
1 AC power cord (3-conductor)
1 Operation manual
1 Fuse (2A) (inside the fuse holder of the oscilloscope as a spare)

3. PRECAUTIONS

The following precautions should be observed to lengthen the service life of this instrument.

Installation site

* Avoid installing this instrument in an extremely hot or cold place.
  - o Avoid placing this instrument in a place exposed directly to sunlight for a long period of time, in a closed car in midsummer, or near a heating device.
  - o The maximum operating ambient temperature is 50°C.

* Do not use instrument that has been left outdoors or stored at sub zero temperatures. The operating ambient temperature is 0°C or more.

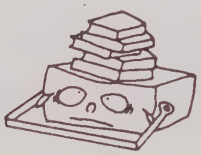
* Avoid excessively damp, wet, or dusty conditions. The operating ambient humidity is 35 to 85%.

* Do not place the instrument in a place subject to strong vibration. Since the oscilloscope is a precision instrument, excessive vibrations may cause damage.

* Do not place the instrument near a magnet or strong magnetic field. An oscilloscope uses an electron beam and will be effected by a strong external magnetic field.

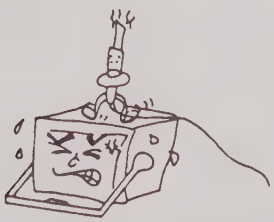
Handling

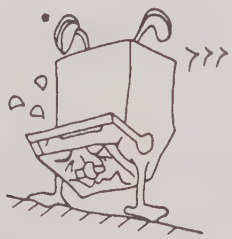
* Do not put a heavy object on the oscilloscope.
* Do not block the ventilation holes.
* Do not apply a heavy shock to the oscilloscope.



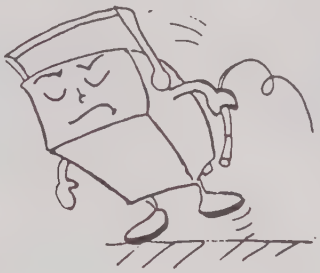
* Do not insert a wire, pin, etc. through the ventillation holes.
* Do not drag or carry the set, leaving the probe attached to it.

* Do not leave a hot soldering iron on and around the cabinet or the screen.
* Do not set the instrument on its face, otherwise knobs may be broken.





* Do not use the instrument upright, when BNC cables are connected to EXT BLANKING, and TRIG SIGNAL OUTPUT terminals on the rear panel (V-1065,V-1065C and V-665 only) unless using a tee or elbow connector. The cables may be damaged.



Faulty operation

* Recheck the operating procedure. If problem persists, contact a local service facility.

Care and repair

* **Removal of stain from the case**
  - o When the surface of the case is stained, remove the stain by first wiping it lightly with a cloth moistened with a neutral detergent and then wipe the surface with a dry cloth.

* **Never use strongly volatile agents such as benzine and thinner.**
  - o When the panel surface is stained, remove the stain with a clean, soft cloth. When heavy stains are present, first remove them by wiping the surface lightly with a cloth moistened with a diluted neutral detergent and then wipe thoroughly with a dry cloth.

Maintenance

(1) Use and store the oscilloscope carefully, so as not to damage the built-in precise components.
(2) Clean the CRT screen and the scale plate from time to time with a clean soft cloth.
(3) Side panel can be removed by unscrewing the screws.
(4) The recommended ambience is 20°C, 65%.

Cautions to be observed before measurement

* **Line voltage check** ⚠
  The operating voltage range of this oscilloscope is 90 to 250 V AC. Check the line voltage without fail before turning on the power switch.
  The oscilloscope is provided with the power cable normal to the country of import.

* **Do not use excessive brightness**
  This will reduce eye strain and reduce the risk of burning the phosphorescent surface of the CRT.

* Do not exceed the rated input voltage of the connector or the probe. Never apply a voltage higher than specified as follows:

INPUT direct	400 V (DC + peak AC at 1 kHz or less)
With probe	500 V (DC + peak AC at 1 kHz or less)
EXT BLANKING	30 V (DC + peak)

CAUTION: A voltage exceeding the above may damage the equipment.

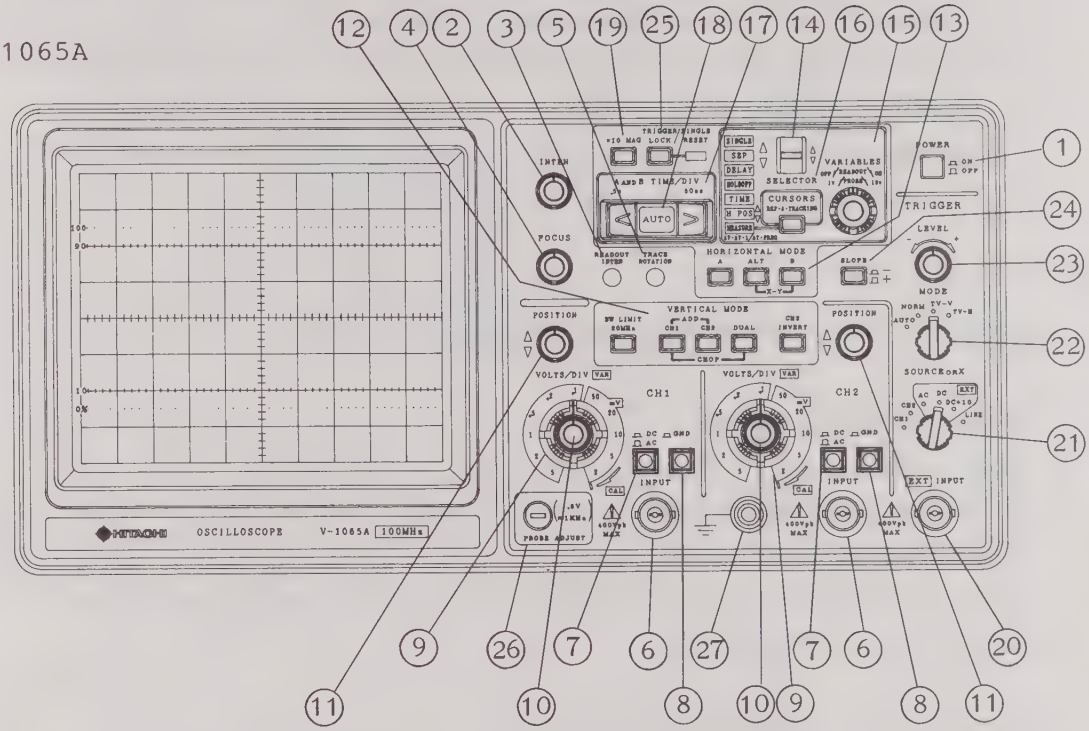
Calibration interval

To maintain instrument accuracy, calibration is recommended at least every 1000 operating hours, or every six months.

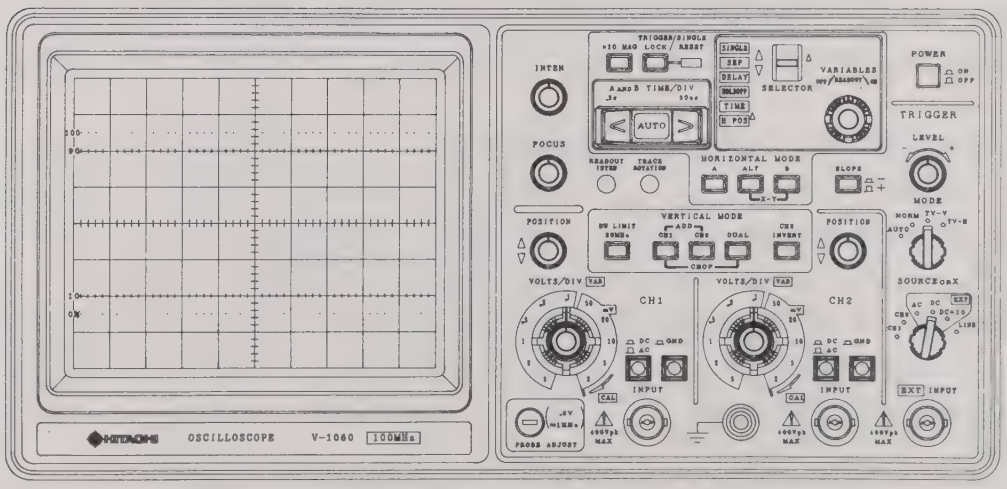
4. PANEL ILLUSTRATIONS

(1) Front panel

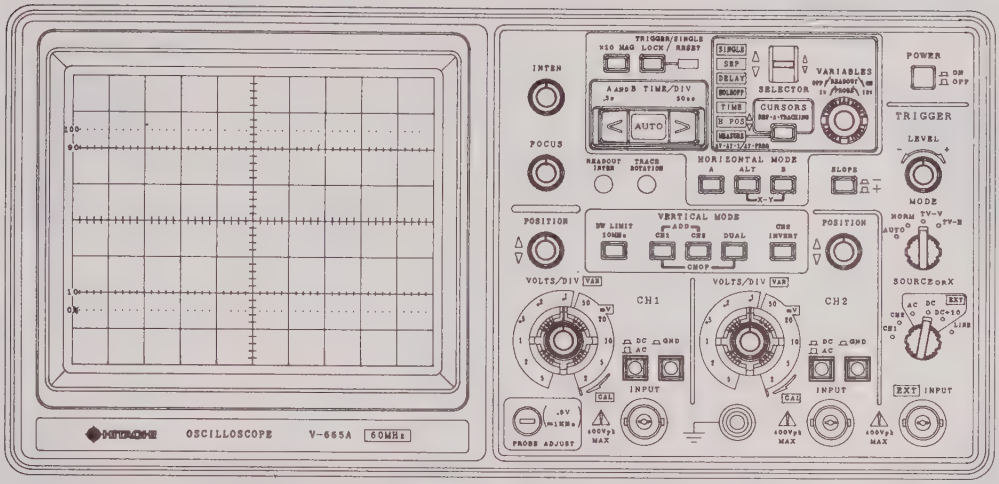
V-1065A



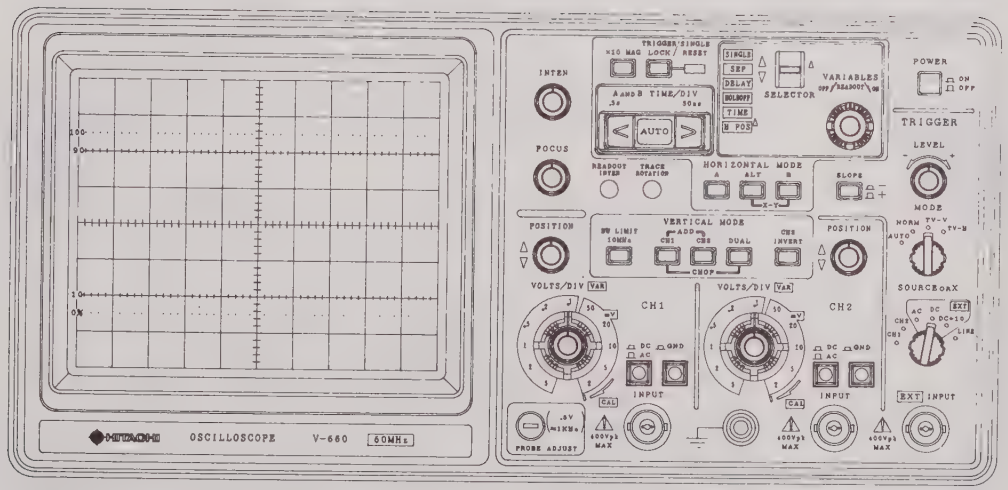
V-1060



V-665A


INTEN
FOCUS
POSITION
VOLTS/DIV
CH1
CH2
INPUT
AUTO
SELECTOR
VARIABLES
POWER
TRIGGER
LEVEL
MODE
SOURCE
EXT INPUT
PROBE ADJUST
OSCILLOSCOPE
V-665A
60MHz

V-660


INTEN
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TRIGGER
LEVEL
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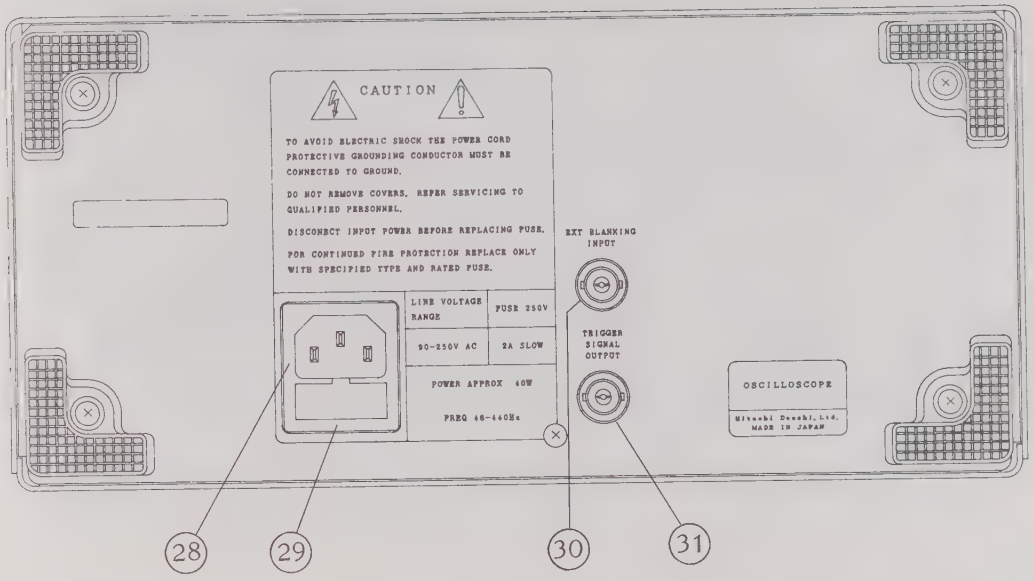
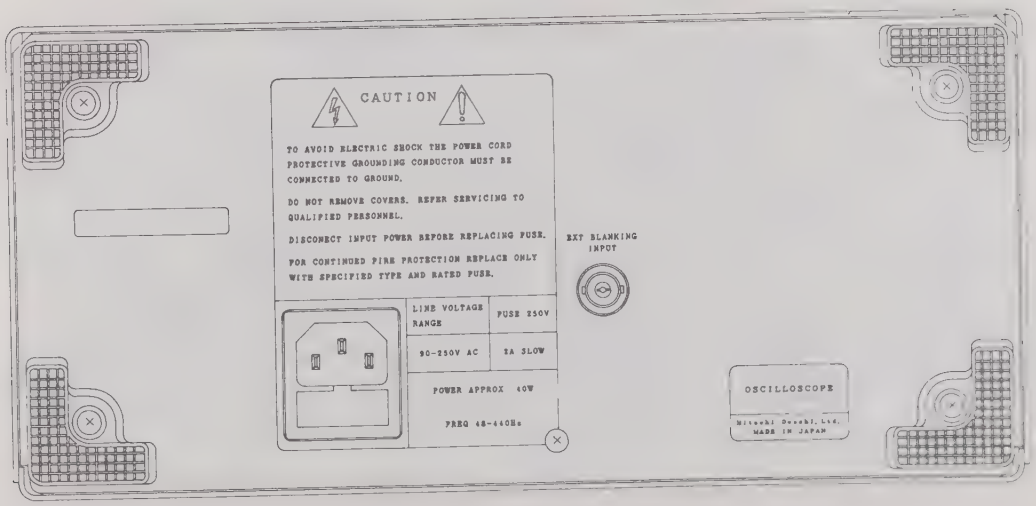
SOURCE
EXT INPUT
PROBE ADJUST
OSCILLOSCOPE
V-660
60MHz

(2) Rear panel

V-1065A, V-665A



V-1060, V-660


CAUTION
TO AVOID ELECTRIC SHOCK THE POWER CORD PROTECTIVE GROUNDING CONDUCTOR MUST BE CONNECTED TO GROUND.
DO NOT REMOVE COVERS. REFER SERVICING TO QUALIFIED PERSONNEL.
DISCONNECT INPUT POWER BEFORE REPLACING FUSE.
FOR CONTINUED FIRE PROTECTION REPLACE ONLY WITH SPECIFIED TYPE AND RATED FUSE.
LINE VOLTAGE RANGE
FUSE 250V
90-250V AC
2A SLOW
POWER APPROX 40W
FREQ 48-440Hz
EXT BLANKING INPUT
OSCILLOSCOPE
Mitsubi Denshi, Ltd.
MADE IN JAPAN

5. PANEL DESCRIPTION

(A) Power and CRT

(1) POWER

Power is ON in the pressed mode (▬), and OFF in the released mode (▮).

(2) INTEN

Adjusts the brightness of a waveform.

(3) READOUT INTEN (screwdriver adjustment)

Adjusts the brightness of characters displayed on the CRT.

(4) FOCUS

After obtaining an appropriate brightness by operating the INTEN control, adjust the FOCUS control until the trace has best definition. Although the FOCUS is corrected automatically when the INTEN control is rotated, focus is subjective. In this case, adjustment is provided.

(5) TRACE ROTATION (screwdriver adjustment)

Corrects a slight tilting of trace caused by external magnetic fields. Align the trace with the horizontal graticule line with this control.

(B) Vertical deflection system

⑥ INPUT

BNC connector for CH1 and CH2 input.

⑦ AC-DC

Selects the method of coupling the input signal to the vertical deflection system.

AC: Input signal is capacitively coupled to the vertical attenuator. The DC component of the input signal is blocked. Minimum frequency response is 10 Hz with 1X probe and 1 Hz with 10X probe.

DC: All frequency components of the input signal are coupled to the vertical attenuator.

⑧ GND

This is an input coupling select switch.
The input of the vertical amplifier is grounded in the pressed mode (⏚).

⑨ VOLTS/DIV

This is a step attenuator which selects the sensitivity.
Set to appropriate range according to incoming signal level.

⑩ VAR controls

* Provide a continuous variable deflection factor.
  Attenuation of up to 2.5X is obtained by turning in a counterclockwise direction.

* These controls are useful when comparing two waveforms or when measuring the rise time of a pulse.
* Normally turned fully clockwise to the CAL position.

⑪ POSITION

Sets the vertical position.
Clockwise rotation moves the associated trace upward while counterclockwise rotation moves it downward.
NOTE: The CH2 signal is inverted (180° out of phase) in the CH2 INVERT mode.

⑫ VERTICAL MODE

Selects the operating mode of the vertical amplifier.

CH1: Displays the Channel 1 signal.
CH2: Displays the Channel 2 signal.
DUAL: Displays the channel 1 and channel 2 signals. (Dual-trace mode)
The display mode is automatically selected by the TIME/DIV switch setting. When the TIME/DIV switch is set to 5 ms/DIV or slower, the CHOP mode is obtained. When the switch is set to faster range, the ALTERNATE mode is obtained.
In case of the ALTERNATE mode, Channel 1 and 2 signals are alternately displayed.
CHOP: When the CH1 and DUAL switches are pressed simultaneously, the CHOP mode is obtained regardless of the sweep rate. Channel 1 and 2 signals are switched at about 250 kHz rate regardless of the sweep and they are simultaneously displayed on the CRT.
This is used for observation of waveforms in the CHOP mode at a fast sweep range.

NOTE: To prevent triggering from chopping transients, apply a triggering signal to the EXT INPUT connector and set the TRIGGER SOURCE to EXT, or set the internal trigger level very carefully.

ADD: Displays the algebraic sum of Channels 1 and 2 when both CH1 and CH2 keys are pressed.

CH2 INVERT:

Allows the polarity of the CH2 signal to be inverted. It is recommended to use this function when comparing different polarity waveforms or when observing differential signals where it is in appropriate to measure with respect to ground and you wish to establish CH2 as the reference.

BW LIMIT:

When this switch is pressed, the bandwidth is reduced to approximately 20 MHz (10 MHz for the V-665 and the V-660) and the observation is made by eliminating interference from undesired high-frequency signals.

(C) Horizontal deflection system

⑬ HORIZONTAL MODE switch

Selects the operation mode of the horizontal deflection.

A: Main sweep (A) appears on the CRT.
This setting is used in normal cases.

ALT: Both main sweep (A) and delayed sweep (B) are displayed. (Cursor measurements are inoperable in this mode.)

B: Delayed sweep appears on the CRT. The sweep time is controlled by the B time base.

X-Y: When the ALT and B switches are pressed simultaneously, an X-Y operation is available.

(14) SELECTOR

Selects the variable functions of the horizontal amplifier and cursor. Move the SELECTOR lever upward and downward to illuminate the desired function lamp. Then adjust the VARIABLES control (15).

SINGLE: Displays the main sweep (A) once.

A/B SEP: Adjusts the vertical position of the delayed sweep (B) in the ALT sweep mode.

DELAY: Used to set the delay time of the delayed sweep (B) starting point with respect to the main sweep (A) starting point. The delay time is displayed on the upper left side of the CRT and the B sweep window is indicated by the cursors.

HOLDOFF: Increases the holdoff time to trigger and aids triggering on complex displays such as high-frequency signal, irregular signal and digital words.

Rotate the HOLDOFF control to obtain stable triggering. The holdoff value is set to the minimum when the power is turned on or when the A TIME/DIV switch (17) is operated. This control is used in conjunction with trigger lock to obtain sweep independent stable triggering on complex wave trains.

TIME: (variable) Adjusts the sweep speed of the main sweep (A) continuously. When the control is turned fully clockwise (CAL position), the sweep speed is calibrated to the specified value. Normally, set to fully clockwise position (A = on the CRT). The variable time is set to the CAL state when the power is turned on or when the A TIME/DIV switch is operated.

H POS: Used to adjust the horizontal direction. Display is moved to right side when the control is rotated clockwise and to left side with counterclockwise rotation.

MEASURE: In this mode, ΔV, ΔT and 1/ΔT can be selected and displayed in turn on the CRT by moving down the SELECTOR lever. Measurements by cursors are available on the V-1065A and V-665A only.

ΔV: Two horizontal cursors appear. The voltage between the two cursors is displayed with ΔV on the upper side of the CRT. It corresponds to the setting of VOLTS/DIV.

ΔT: Two vertical cursors appear. The time between two cursors is displayed with ΔT on the upper side of the CRT. It corresponds to the setting of TIME/DIV.

1/ΔT: Two vertical cursors appear. The reciprocal of the time (frequency) between two cursors is displayed with 1/ΔT on the upper side of the CRT. It corresponds to the setting of TIME/DIV.

FREQ: The frequency counter is interlocked with triggering and the measurement starts from the triggering point.

(15) VARIABLES

Sets the function selected by the SELECTOR (14). Clockwise rotation moves the trace up(↑) or right(→). Counterclockwise rotation moves the trace down(↓) or left(←).
A combination use with the SELECTOR can blank characters on the CRT and calculate values of the 1X and 10X modes of a probe. (For details, refer to section 8, sub section A (5), NOTES (a) and (b).)

⑯ CURSORS REF•Δ•TRACKING (V-1065A, V-665A only)

REF: Moves the reference cursor on the CRT. (▽ or ▷ is displayed on one cursor.)

Δ: Moves the measuring cursor on the CRT. (▽ or ▷ is displayed on one cursor.)

TRACKING: Simultaneously moves the reference cursor and the measuring cursor with the interval between the two cursors unchanged. (▽ or ▷ is displayed on two cursors.)

⑰ A AND B TIME/DIV

Sets the sweep time of the main sweep (A) and the delayed sweep (B). The sweep is set by the HORIZONTAL MODE switch ⑬ and the sweep time is displayed on the CRT.

A sweep time: 0.5 s/DIV - 50 ns/DIV
B sweep time: 50 ms/DIV - 50 ns/DIV

The B sweep time is always set faster than the A sweep time except in the 50 ns/DIV.

NOTE:
When the TIME/DIV switch is operated, the characters on the CRT may become blank momentarily.

(18) AUTO

When the center of the TIME/DIV switch is pressed, the AUTO lamp lights. The incoming signal is detected, the time range changes automatically, and approx. 1.6 to 4 waveforms are displayed on the CRT. (For signals of 100 Hz or in the absence of a trigger, the time range is set to 5 ms/DIV. For signals of approx. 8 MHz or more, the time range is set to 50 ns/DIV.) The time range automatically changes according to the incoming signal. (For details, refer to section 8, sub section J.)

(19) x10 MAG

Used to magnify A and B sweeps to 10 times. In this case, the sweep time is 1/10 times the value indicated by TIME/DIV. Bring the portion of the waveform to be magnified to the center of the CRT by selecting [H POS] and rotating VARIABLES (15). Then press the x10 MAG switch and the waveform placed at the center is magnified.
By controlling the x10 MAG, the sweep speed readout is automatically converted.

(D) Trigger system

(20) EXT INPUT

BNC connector for an external trigger signal, an external sweep signal, or an external X input.

(21) TRIGGER SOURCE OR X

Selects the trigger signal source or the X signal for an X-Y operation.

CH1: The signal fed to CH1 is used.

CH2: The signal fed to CH2 is used.

EXT AC: The signal fed to EXT INPUT is used as a signal after the DC component is removed.

EXT DC: The signal fed to EXT INPUT is used as is. This signal is used when affecting synchronization to a very low frequency signal.

EXT DC÷10: The signal fed to EXT INPUT is attenuated to 10:1 and used as a signal. This signal is used when affecting synchronization to a very low frequency.

LINE: Used to observe the signal synchronized to a line frequency.

(22) TRIGGER MODE

AUTO: The instrument will automatically display a trace without an input signal being applied or out of trigger. This setting is convenient in most cases.
Normal trigger will be established by setting trigger level when a signal is applied to the input.
The trigger level corresponds to the amplitude of the incoming signal and synchronization is easily executed.

NORM: No trace will appear, unless a signal or external trigger is present. Use this MODE when effecting synchronization to a very low frequency signal (30 Hz or less) or for arming single sweep.

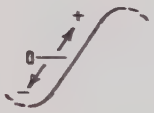
TV-V: Used when observing the entire vertical video signal.

TV-H: Used when observing the entire horizontal video signal.

(23) TRIGGER LEVEL

By controlling the trigger level, the sweep start point of the waveform is set.

Explanation of trigger LEVEL



During ⊕ SLOPE

During ⊖ SLOPE

(24) SLOPE

Select the triggering polarity of (+) or (-).

During
⊕ SLOPE

Triggered on the continuous line

During
⊖ SLOPE

㉕ TRIGGER LOCK/SINGLE RESET

When the SINGLE RESET switch is not operated:

When the TRIGGER LOCK switch is pressed and the lamp is lit, the synchronized state before the lamp is lit is held. If the synchronization is executed before the lamp is lit, and the TRIGGER LOCK switch is pressed, the stable synchronization is ensured when the sweep time and the variable time are changed.

When the SINGLE RESET switch is pressed and the lamp is lit:

The single sweep is armed.

NOTE:

When the TRIGGER MODE switch is set to AUTO, the sweep is performed once by pressing this switch, asynchronously with the incoming signal. Usually the single sweep function is used in conjunction with NORM triggering to detect and trigger on anomalies, aberrations, or one time events.

(E) Miscellaneous

㉖ PROBE ADJUST

A 0.5 V-1 kHz squarewave signal is available. This terminal is used for probe calibration.

㉗ GND terminal (⏚)

Earth terminal grounding.

(F) Rear panel

㉘ AC input connector

Provides the connection point for the AC power source to the instrument.

㉙ FUSE

The fuse is inside the fuse holder.
CAUTION: When the fuse is blown out, contact your nearest Hitahci Denshi representative.

㉚ EXT BLANKING INPUT

This is a terminal for applying a blanking signal from an external source. The trace displayed on the screen may be intensity-modulated where pulse signal or time-scale marks are required.

㉛ TRIGGER SIGNAL OUTPUT (V-1065A, V-665A)

The signal selected by the TRIGGER SOURCE OR X control ㉑ is available.

6. HOW TO PRODUCE THE TRACE

Before turning ON the POWER switch, insure the AC supply voltage is within the range of 90 to 250 V AC supply.
Connect the power cord on the rear panel to an AC outlet and set the controls as follows.

GND	▬	(Pressed mode)
POSITION	Midrange	

Turn the POWER switch on, set the HORIZONTAL MODE to A, set the TRIGGER MODE to AUTO, and rotate the INTEN control clockwise, and a trace appears.
Adjust the FOCUS control to obtain the sharpest trace.
When this instrument is not in use, with power supplied, rotate the INTEN control counterclockwise to decrease the intensity. This protects the CRT from image burn and increases its life expectancy.

NOTES:

(1) For normal operation, the following function must be set in the 'CAL' position.

VOLTS/DIV VAR: Push in and rotate in the fully clockwise direction. In this case, the VOLTS/DIV is calibrated to the indicated value.

TIME/DIV VAR: Set the time by the SELECTOR (14), and turn the TIME control clockwise until A = is displayed on the CRT. The variable time is initialized when the power is turned on or when the time range of the A sweep is changed. At this time, the A TIME/DIV is calibrated to the indicated value.

(2) Align the GND trace with the horizontal graticule line at the center of the screen by operating CH1 POSITION control. In some cases, the trace may be slightly oblique to the scale by the effect of earth magnetism.
In this case, align the trace with the horizontal graticule line at the center of the screen by properly adjusting the TRACE ROTATION control (screwdriver adjustment) on the front panel.

7. METHOD FOR CONNECTING SIGNALS

The first step of measurement is to connect the signal to the oscilloscope properly. Do it with utmost care.

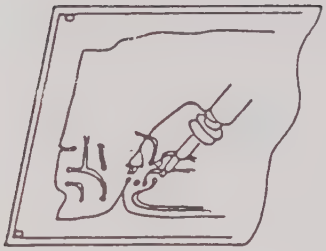
WARNING: When connecting the probe or the signal input cable to the circuit to be measured, be sure to connect the ground side of the probe or the signal input connector to the ground side of the signal source. If not, potential difference between the oscilloscope and other equipment or earth ground may result in shock hazard and damage the oscilloscope, the probe, and other equipment.

(A) Using probes

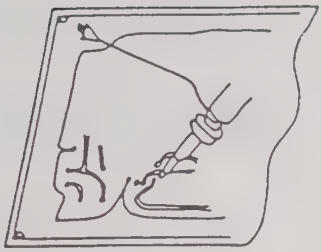
Use the attached probe, when measuring a high frequency wave with high accuracy.
It should be noted, however, that since the input signal is attenuated by this probe to 1/10 before it is input to the oscilloscope, the use of the probe is disadvantageous for low level signals, and that at the same time the measuring range is extended by that amount for high level signals.

<NOTES>

- Do not apply a signal to the input in excess of 500 V (DC + peak AC at 1 kHz or less).
- Connect the probe ground lead as close as possible to the point being measured especially when measuring a fast rise time or a high frequency signal.
  Long probe ground leads may cause waveform distortions, such as ringing and overshoot.



(a) Proper



(b) Improper

Connection of ground lead

- To avoid effect of the ground lead in high frequency measurement, it is recommended to use the standard ground lead attachment with the AT-10AS1.5 probe.
- To avoid measurement error, probe compensation must be done especially when probes are changed on the instrument. Connect the probe tip to the PROBE ADJUST 0.5 V output terminal and the probe tip to the GND terminal. A 1kHz square wave should be displayed with flat tops. Any distortion in the presentation is caused by incorrect probe compensation. If overshoot or undershoot is present, turn the screwdriver adjustment in the probe for a flat-top presentation.

(a) Optimum

(b) Capacity too small

(c) Capacity too large

(B) Direct connections

If you are connecting signals without using the supplied probe, pay attention to the following points in order to minimize measurement error.

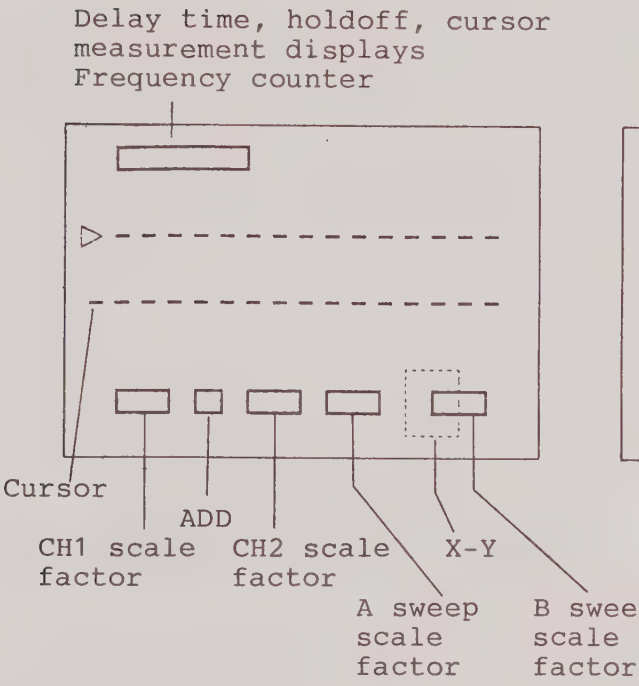
- o When using unshielded leads there should be no trouble provided they are high level signals from a low impedance source. However, in most cases, measurement errors may be caused by stray coupling with other circuits or power line interference.
  This can cause errors even at low frequencies.
  In general, avoid measuring with non-shielded wire. When using a shielded wire, it is desirable to use a coaxial cable with a BNC type connector. If a BNC type connector is not available, connect one end of the shield to the ground terminal of the oscilloscope and the other end to the ground of the circuit to be measured.
- o The following precautions must be observed when performing a wide bandwidth measurement. It is necessary to terminate the cable with a characteristic impedance, when measuring a fast rise waveform or a high frequency wave.
  The absence of a termination resistor will necessarily lead to a measurement error derived from ringing phenomenon in long cable. Some measuring circuits require a termination resistor equal to the characteristic impedance of the cable also be applied at the measurement point. (A BNC type termination resistor is recommended for this purpose).
- o In order to perform measurements with the circuit in a proper operating state, it is sometimes necessary to terminate the cable with an impedance which corresponds to the circuit being measured.

- The stray capacity of the shield wire must be taken into account when performing measurements with a long shield. Since the shield wire normally in use has a capacity of about 100 pF per meter, its effect on the circuit to be measured cannot be ignored.
  Use a x10 probe to minimize the effect on the circuit.
- When the length of the shield wire used or when the length of the non-terminated cable reaches 1/4 the wave length or its multiples within the band of the instrument (1/4 the wave length is about 0.5 meter when using a coaxial cable at 100 MHz), oscillation may be caused in the 2 and 5 mV/DIV range.
  This is caused by the resonance between the externally connected high-Q inductance and the input capacity. Reduce the Q by connecting the cable or shield wire to the input connector by the resistors connected in series, or by performing measurements at another VOLTS/DIV range.

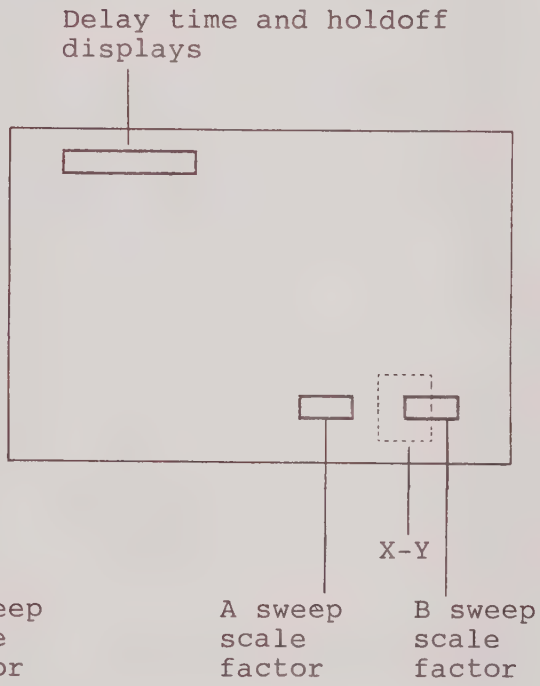
(A) Readout function

Display allocation on the CRT

V-1065A, V-665A



V-1060, V-660



① CH1 and CH2 scale factor displays (V-1065A, V-665A)

Probe display

P_{10X} : 10X probe

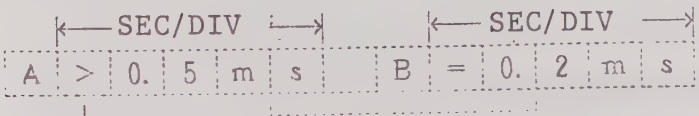
Blank: 1X probe or others

Blank : CAL

> : UNCAL

In the ADD mode, + is displayed between CH1 and CH2.

② A sweep, B sweep, and X-Y scale factor displays



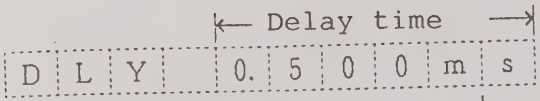
=: X1 CAL

*: X10 MAG

>: UNCAL

In the X-Y operation mode, X-Y is displayed and the TIME/DIV settings disappear.

③ Delay time display



ms: A TIME/DIV (CAL)

div: A TIME/DIV (UNCAL)

Shows that the HORIZONTAL MODE switch is set to ALT or B.

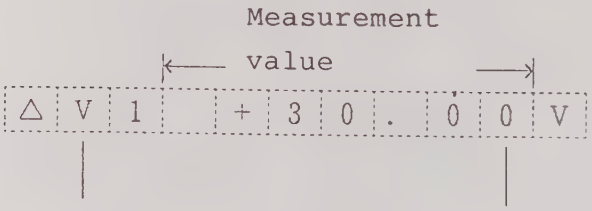
(4) HOLDOFF and TRIGGER LOCK displays

MIN: Minimum
>>>: Holdoff time is graphed.
MAX: Maximum

Displayed in the trigger lock mode.

⑤ Cursor measurement value display (V-1065A, V-665A)

A measurement value between cursors is displayed.



ΔV1: CH1
ΔV2: CH2
ΔV$^{1}_{2}$: ADD
ΔTA: Time difference between two cursors for A TIME/DIV
1/ΔTA: Reciprocal number of ΔTA
ΔTB: Time difference between two cursors for B TIME/DIV
1/ΔTB: Reciprocal number of ΔTB

ΔV: +, -, mV, V, div
ΔT: +, -, ns, μs, ms, s, div
1/ΔT: mHz, Hz, kHz, MHz, ?

"div" is displayed in the following cases:

- o The measurement value in the channel selected by the VERTICAL MODE switch is not in the CAL state.
- o The VOLTS/DIV settings of CH1 and CH2 in the ADD mode are not equal.
- o The HORIZONTAL MODE switch is A and the TIME switch and the VARIABLES control function. (UNCAL state, CRT display:>)

NOTES

(a) Readout display appears when the power is turned on. If this display is not needed, select [H POS] by the SELECTOR, move the SELECTOR upward to light [TIME], and rotate the VARIABLES counterclockwise while holding the SELECTOR upward. The readout display then disappears.
To obtain the readout display again, select [H POS], move the SELECTOR upward, and rotate the VARIABLES clockwise, while holding the SELECTOR upward.

(b) The P_{10X} display is initialized when the power is turned on. To blank the display, select [H POS], hold the SELECTOR downward, and rotate the VARIABLES counterclockwise.
To obtain the display again, select [H POS], hold the SELECTOR downward, and rotate the VARIABLES clockwise.
The probe display can be switched to 1X or 10X only for the channel selected by the VERTICAL MODE switch.

(B) General measurement

① Observing a single waveform

Use Channel 1 or 2 when not observing the phase difference between two waveforms or when engaging in an operation other than X-Y operation.
Make the following settings when using Channel 1.

VERTICAL MODE switch:	CH1
TRIGGER MODE switch:	AUTO
TRIGGER SOURCE OR X switch:	CH1
AC-DC switch:	AC or DC

Under these settings all repetitive signals higher than 30 Hz applied to Channel 1 can be triggered on and observed by adjusting the A TRIGGER LEVEL control, with a TIME/DIV range of 2 ms/DIV or faster. Since the TRIGGER MODE is set to the AUTO position, a trace appears even when no signal is present or when GND switch is in the GND position. Therefore, DC voltage measurement can be made when the switch is placed to DC. When observing ultra-low frequency signals below 30 Hz, the following switch settings are required;

TRIGGER MODE:	NORM

Triggering can be effected by operating the LEVEL control under this setting.
When observing a signal of lower than 30 Hz, using other than CH1, use CH2, EXT DC or EXT DC ÷10 as a sync signal source.

② Observing two waveforms

Observation of two waveforms can be made easily by pressing the DUAL key of the VERTICAL MODE.

NOTES

i) When the A TIME/DIV setting is at 5 ms/DIV or slower in the DUAL mode, the mode is automatically set to the chop mode.
When the TIME/DIV setting is at 2 ms/DIV or higher, the mode is automatically set to the alternate mode.
If the chop mode is required when the TIME/DIV setting is at 2 ms/DIV or higher, press both the CH1 and DUAL keys.

ii) To measure phase difference, trigger on the leading signal.

③ Observing a waveform in the X-Y mode

Set the HORIZONTAL MODE to X-Y so that an X-Y oscilloscope is available. The X axis input is selected by the TRIGGER SOURCE OR X switch and the Y axis input is selected by the VERTICAL MODE switch to the CH1, CH2 and DUAL modes.

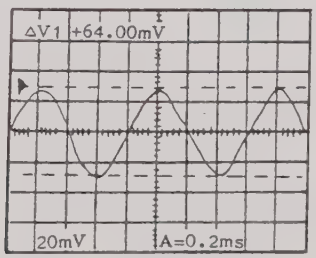
For the X-Y operation, set the x10 MAG key and the BW LIMIT key to off.

(C) Voltage measurement

① ΔV cursor measurement (V-1065A, V-665A)

The measurable area by the ΔV cursors is 3 divisions above and/or below the center horizontal graticule line.
Set the VOLTS/DIV switch so that a waveform is within the area.
When a signal including a DC component is measured in the DC coupling mode, also set the POSITION control to set the GND trace within the measurable area.
When the [MEASURE] is selected by the SELECTOR, two horizontal cursors appear on the CRT. The voltage between the reference cursor and the Δ cursor is displayed with "ΔV" on the upper side of the CRT. The voltage becomes "+" when the Δ cursor is above the reference cursor, while it is "-" when the Δ cursor is below the reference cursor.
The cursor selected by the CURSORS REF•Δ•TRACKING switch moves up when the VARIABLES control is turned CW, while it moves down when the control is turned CCW.
To measure the voltage from the GND line, press the GND switch to display the GND line, and align the reference cursor with the GND line. Switch the input coupling mode to DC, and align the Δ cursor with the level to be measured.

ΔV cursor measurement for AC voltage



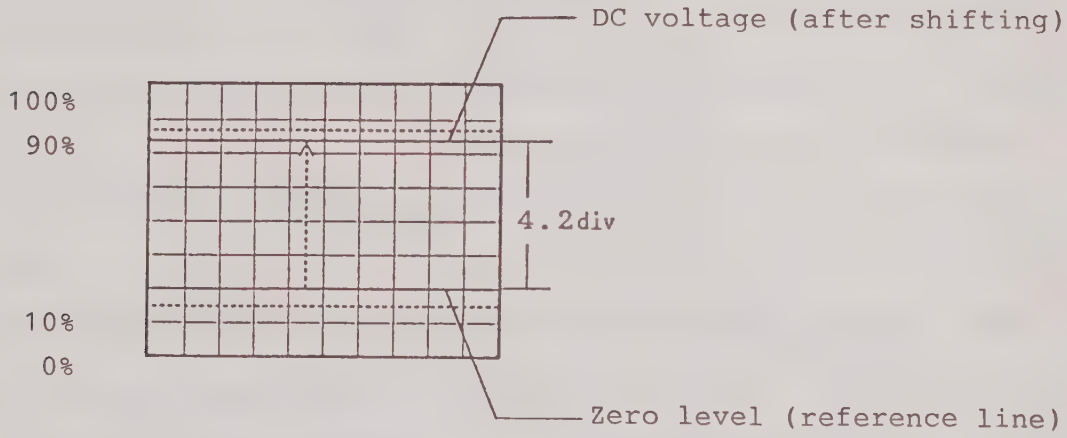
Δ cursor
REF cursor

NOTES:

ⓐ When the VERTICAL MODE switch is set to DUAL, only the measurement value of CH1 (ΔV1) is displayed.

ⓑ When the HORIZONTAL MODE switch is ALT or X-Y, the ΔV cursor cannot be selected.

② Visual measurement



Set the GND switch to GND and obtain the base-line trace. Set the AC-DC switch to DC and set the VOLTS/DIV switch to obtain an optimum amplitude waveform. Since the trace shifts by the amount of DC voltage, the DC voltage of the signal can be obtained by multiplying the shift by the indicated value of VOLTS/DIV. When VOLTS/DIV is 50 mV/DIV, then 50 mV/DIV x 4.2 = 210 mV (However, if a 10x probe is in use, the true value of the signal becomes 10 times the value, it will be 50 mV/DIV x 4.2 x 10 = 2.1 V).

(D) Time and frequency measurement

① ΔT cursor measurement (V-1065A, V-665A)

When the [MEASURE] is selected by the SELECTOR, the ΔV cursor appears on the CRT.
Then, when the SELECTOR is moved downward once so that the ΔT cursor measurement mode is established, the measurement value will be displayed with ΔT on the upper side of the CRT.
The measurable area by the ΔT cursor is 4 divisions from the center vertical graticule line on the right and left sides.
Set the TIME/DIV switch so that the desired portion of a waveform is as large as possible.
The two cursors selected by the CURSORS REF•Δ•TRACKING switch can be shifted by the VARIABLES control.

The positive or negative polarity corresponds to the two cursor positions;

+: The Δ cursor is located on the right side of the reference cursor.

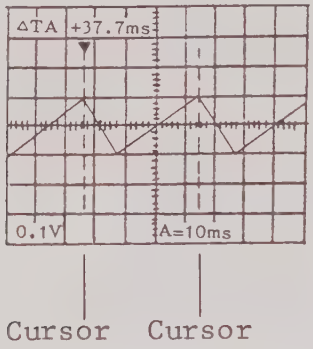
-: The Δ cursor is located on the left side of the reference cursor.

Clockwise rotation of the VARIABLES control moves the cursor to the right; counterclockwise rotation moves it to the left.

NOTES:

ⓐ In ALT or X-Y operation of the horizontal display mode, the ΔT cursor measurement cannot be selected.

ⓑ The measurement value is displayed in divisions when the TIME switch and the VARIABLES control function produce an uncalibrated sweep.
(UNCAL state, CRT display:›)



② 1/ΔT cursor measurement (V-1065A, V-665A)

When the MEASURE is selected by the SELECTOR, two cursors will appear on the CRT. When the SELECTOR is moved down twice, 1/ΔT is displayed on the upper side of the CRT.
When the two cursors are superimposed at two edge points of the one period waveform by the VARIABLES control, the reciprocal number of delta-time between two cursors is displayed with 1/ΔT on the upper side of the CRT.
Clockwise rotation of the VARIABLES control moves the cursor to the right; counterclockwise rotation of the control moves the cursor to the left.

NOTES:

ⓐ In ALT or X-Y operation of the horizontal display mode, the 1/ΔT cursor measurement cannot be selected.

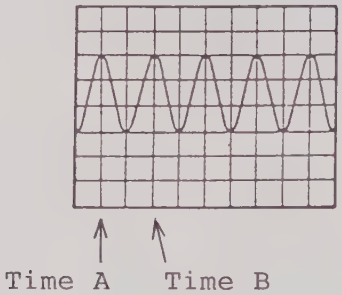
ⓑ The measurement value is displayed in divisions when the TIME switch and the VARIABLES control function produce an uncalibrated sweep.
(UNCAL state, CRT display:›)

③ Visual time measurement

The illustration below shows one period of time between A and B, which represents 2.0 DIV.
When the sweep time is 1 ms/DIV, the period is given by

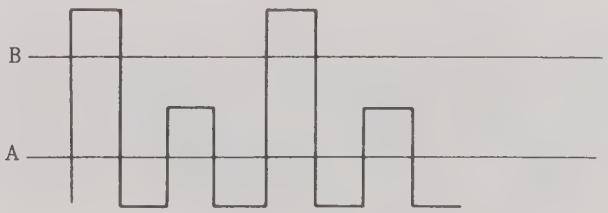
1 ms/DIV x 2.0 = 2.0 ms

$(2.0 \times 10^{-3}s)$



④ Frequency measurement (V-1065A, V-665A only)

When [MEASURE] is selected by the SELECTOR switch, the ΔV cursor is displayed on CRT. Then press the SELECTOR switch three times to display FREQ at the upper part of CRT.
The frequency counter is interlocked with triggering and the measurement starts from the triggering point.
Consequently, any special frequency having complex waveforms can be measured by changing the trigger level.
For example, when a signal as illustrated below is applied, the frequency of the entire waveforms can be measured when triggered at point A. When triggered at point B, the frequency of a pulse with large amplitude can be measured.



Note:

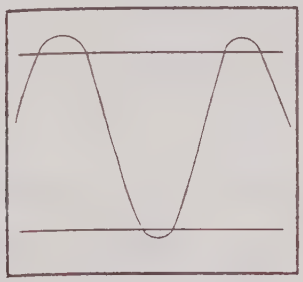
When triggering is not performed, the measurement can not be performed, since the counter is interlocked with the triggering. In the non-triggering mode or in case of the input signal of less than 20 Hz, the message "FREQ ?" is displayed.

(E) Operation of the AUTO trigger function

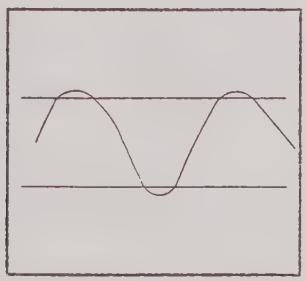
When the TRIGGER MODE switch is set to AUTO, the instrument automatically displays a sweep if an input signal is not applied.

The trigger level is set according to the amplitude of input signal as shown in Figs. (a) and (b).

The AUTO TRIGGER LEVEL setting function eliminates troublesome triggering.


Trigger level variable range
Maximum trigger level (LEVEL control fully rotated clockwise.)
Minimum trigger level (LEVEL control fully rotated counter-clockwise.)

(a) Input signal of large amplitude


Maximum trigger level (LEVEL control fully rotated clockwise.)
Minimum trigger level (LEVEL control fully rotated counter-clockwise.)

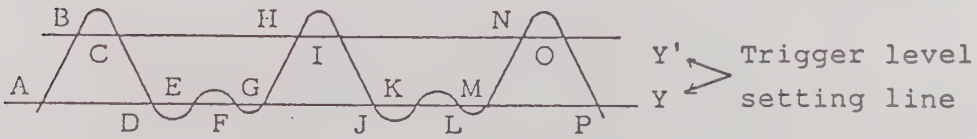
(b) Input signal of small amplitude

When the TRIGGER LEVEL switch is set to NORM, the trigger level is set regardless of the input signal level.

NOTE: When the TRIGGER MODE switch is set to AUTO, it takes 2 or 3 seconds to obtain a stable trigger since the trigger level is automatically set according to the amplitude of an input signal.

(F) Operation of the TRIGGER LEVEL control

In the case shown in Fig. (a) where waveforms are greatly different in amplitude, the waveform is doubled if the TRIGGER LEVEL control is not set properly. In the case where the trigger level is selected by line Y, two waves, one starting with A and advancing to B, C, D, E, F,... and the other starting with E and advancing to F, G, H, I..., will appear alternately on the screen. They will be doubled as shown in Fig. (b).
In such a case, rotate the LEVEL control clockwise until the trigger level comes to Y' line. Then the waveform on the screen becomes the one as shown in Fig. (c) which starts with B and advances to C, D, E, F,... and allows triggering.



(a) Signal waveform

(b) When the trigger setting level is Y

(c) When the trigger setting level is Y'

Triggering of complex waveform

(G) Operation of the HOLDOFF function

① In case of measuring a high frequency signal
Slight jitter may occur on a high frequency signal of 5 MHz approx. or more. In this case adjust the HOLDOFF control so that the jitter is eliminated and a stable trigger is obtained.

② In case of measuring a complex waveform as shown in(a)
It is possible that the triggering is doubled as shown in (b) by the TRIGGER LEVEL control. In such a case, light the HOLDOFF by the SELECTOR and adjust the VARIABLES control to obtain the proper waveform as shown in (c).

(a) Signal waveform

(b) Before using HOLDOFF

(c) After using HOLDOFF

Triggering of complex waveforms

(H) Operation of the TRIGGER LOCK function

Triggering can be doubled when the sweep range is changed after performing the HOLDOFF adjustment.
In such a case, light the HOLDOFF by the SELECTOR.
When the TRIGGER LOCK lamp is lit with the waveform triggered, the triggering is not doubled if the sweep range is changed.
If the TRIGGER LOCK function is not required, press the TRIGGER LOCK switch again so that the lamp goes off and this function is released.

(a) Waveform triggered by HOLDOFF, etc.

(b) Magnified with TRIGGER LOCK OFF

(c) Magnified with TRIGGER LOCK ON

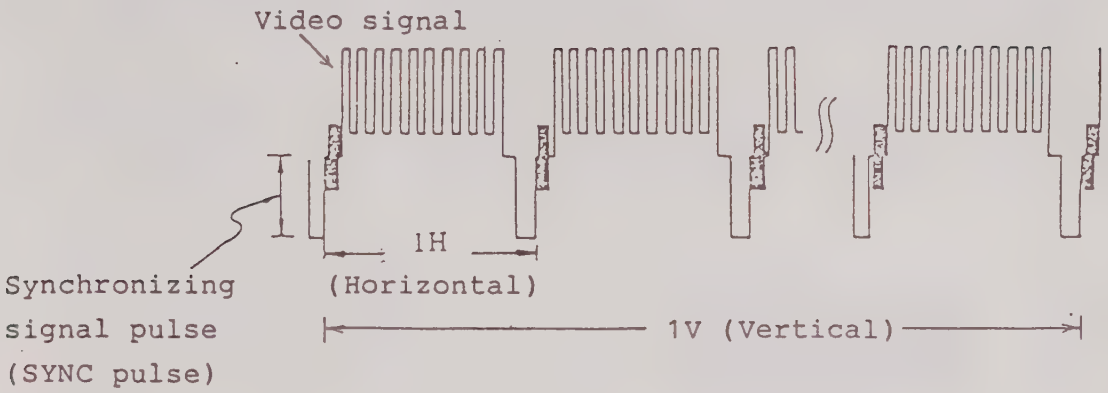
Triggering of complex waveforms

NOTE:

The A TIME/DIV range and the TIME VARIABLE range in the TRIGGER LOCK mode cannot be set to the level slower than that when the signal is locked.

(I) Operation of the TV trigger function

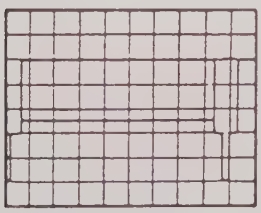
① Video signal of TV



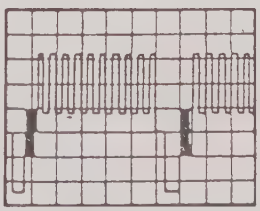
In video work, a composite signal containing a video signal and a sync signal is often measured.

② Operation

To observe a vertical signal To observe a horizontal signal



TRIGGER MODE: TV-V

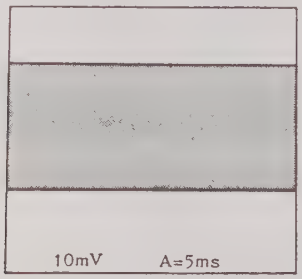


TRIGGER MODE: TV-H

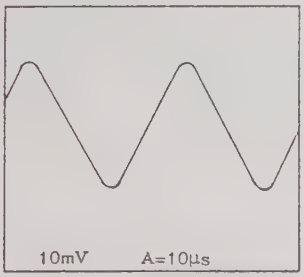
The polarities of the video and sync signals are automatically set. The trigger level setting is not required in the TV mode.

(J) Operation of the AUTO range function

In the normal measurement, the sweep range is set by the TIME/DIV switch. When the AUTO lamp is lit by pressing the AUTO switch with the signal triggered, the input signal is detected, the sweep range is automatically set, and 1.6 to 4 waveforms are displayed on the CRT. This is recommended when the time relation of an input signal is unknown or the input frequency changes with time.



(a) Before using AUTO range



(b) After using AUTO range

NOTES:

(a) The AUTO range does not function when the trigger is not obtained. The AUTO range functions with the trigger signal selected by the TRIGGER SOURCE OR X and TRIGGER MODE switches.

(b) Since the operable time range is 5 ms/DIV to 50 ns/DIV, the signal of 100 Hz or less, or 8 MHz or more is not displayed as 1.6 to 4 waveforms. The time range is set to 5 ms/DIV for the signal of 100 Hz or less or in case of out of trigger, and set to 50 ns/DIV (maximum) for the signal of 8 MHz approx. or more.

(c) The HORIZONTAL MODE switch should be set to A.

ⓓ When the AUTO range functions with the VERTICAL MODE switch set to DUAL, the dual trace operation is always performed in the CHOP mode. For observing the waveforms at high speed, release the AUTO range function by setting the A AND B TIME/DIV switch to the high speed mode or the low speed mode.

ⓔ In case of measuring a complex waveform such as a TV signal, it may take several seconds to perform the AUTO range function.

ⓕ In case of measuring a complex waveform, the time range can be automatically changed and the waveform cannot be measured easily. In this case, release the AUTO range function.

ⓖ In the X10 MAG mode, the ten times waveforms of 1.6 to 4 cycles are displayed.

(K) Operating procedure of delayed sweep

A delayed sweep is used to magnify any portion of a complex waveform in the horizontal direction.
Press the A switch of the HORIZONTAL MODE, effect triggering by A sweep and set the switches as follows.

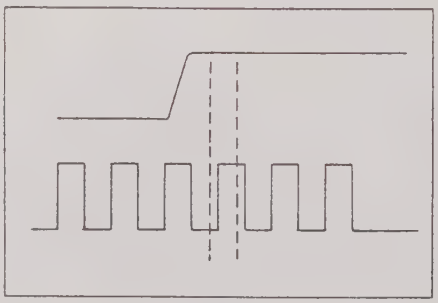
HORIZONTAL MODE : ALT
A TIME/DIV : As desired
B TIME/DIV : Setto the time range to be magnified.

A and B sweeps appear simultaneously on the CRT, DELAY is automatically set by the SELECTOR, and the two cursors will appear.
The two cursors will move continuously by the VARIABLES control. Bring the cursors to the position to be magnified. Then, the waveform between the cursors is magnified to occupy the full area of the screen.

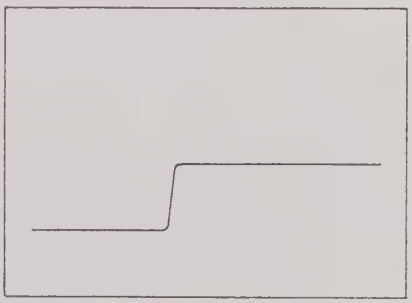
The time from a starting point of the A sweep to that of the B sweep is displayed on the upper side of the CRT.
To measure the magnified waveform only, set the HORIZONTAL MODE to B.

After magnifi-Cation

Before magnifi-Cation



(a) HORIZONTAL MODE: ALT



(b) HORIZONTAL MODE: B

The B sweep trace can be shifted vertically about ±3 divisions with respect to the A sweep trace for the convenience of observation by the A/B SEP switch. The vertical variable range is initialized to approx. +2. divisions with respect to the A sweep trace. By setting the VERTICAL MODE to the dual mode in the ALT sweep mode, two more traces, four traces in total, appear on the CRT.

NOTES:

ⓐ Since traces are alternately displayed in the ALT sweep mode, flicker can occur in the slow sweep rate.
To avoid this, set the TIME/DIV switch to the 0.2 ms/DIV or higher.

ⓑ The time range of the B sweep is designed to be always higher than that of the A sweep (except in the 50 ns/DIV). When the oscilloscope is used in the ALT or B mode, or when the time range of the A sweep is to be changed, set the HORIZONTAL MODE to A first.

ⓒ As the magnification ratio increases in the delay sweep mode, the intensity decreases. If the focus of the trace is adjusted to be optimum at this time, a proper focus cannot be obtained for characters, which is not suitable for photographing. Therefore, do not increase the intensity too much, or blank characters for photographing.

ⓓ The interval between two cursors in the delay sweep mode is designed to be always 0.5 div or more on the CRT, so that easy observation is ensured when the magnification ratio is increased.
Therefore, all the waveform between the cursors is not magnified when the magnification ratio is increased. To verify what part of the A sweep is magnified, check the delay time and the A sweep time displayed on the upper left side of the CRT.

ⓔ Cursors in the ALT sweep mode disappear when the X10 MAG mode is established.

(L) Measurement of transient phenomena

To measure or photograph a single-shot signal and a complex waveform such as an impulse wave, an audio signal, noise from a switch, etc., perform the single sweep operation.

① Single sweep measurement for a waveform to be easily triggered

Set the HORIZONTAL MODE to A, and the TRIGGER MODE to NORM. Connect a vertical signal to be observed or a repetition waveform having the same amplitude as the above signal, and rotate the TRIGGER LEVEL control to obtain a proper triggering.
Select [SINGLE] by the SELECTOR, press the SINGLE RESET switch, and check that the single sweep is performed.
Disconnect the vertical signal from the oscilloscope (press the GND switch, for example), press the SINGLE RESET switch again, and check that the SINGLE RESET lamp lights.
When the vertical signal is connected again , the single sweep is performed. At the time, the SINGLE RESET lamp goes off.

② Single sweep measurement for a waveform hard to be triggered

Set the TRIGGER MODE to AUTO, the HORIZONTAL MODE to A, and select [SINGLE] by the SELECTOR.
Press the SINGLE RESET switch so that the single sweep is performed.

NOTES:

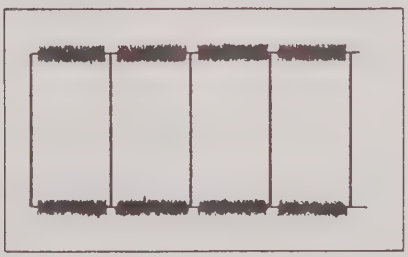
ⓐ If the TRIGGER LEVEL control is rotated, the sweep is performed even when no signal is supplied. After the SINGLE RESET lamp lights, do not rotate the TRIGGER LEVEL control.

ⓑ For a general single shot measurement, set the TRIGGER MODE to NORM.

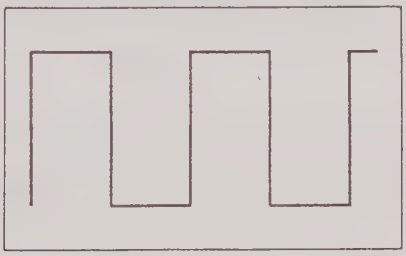
ⓒ When the HORIZONTAL MODE is set to ALT or B, the single sweep cannot be performed.

(M) Operation of the BW LIMIT function

When it is hard to observe or trigger a signal because a high-frequency component is superimposed on the signal, use the BW LIMIT function.
By the BW LIMIT function, the component of approx. 20 MHz or more (for V-1065A and V-1060) or approx. 10 MHz or more (for V-665A and V-660) of the sync signal can be eliminated.



(a) Before the BW LIMIT functions



(b) After the BW LIMIT functions

NOTE:
When the BW LIMIT fucntion is used, the frequency bandwidth is approx. 20 MHz (for V-1065A and V-1060) or approx. 10 MHz (for V-665A and V-660).

(N) High accurate time base calibration

When the power is turned on, the built-in microprocessor automatically starts to calibrate the time base.
To perform a more accurate time base calibration and the waveform measurements which correspond to ambient conditions, turn off the power after fifteen minutes approx. from the power on, and then turn it back to on after three seconds approx.

(O) System reset

In case of abnormal AC power, etc., the built-in microprocessor can malfunction. In this case, press the POWER switch to OFF, and then ON after three seconds or more to reset the microprocessor. Allow 20 seconds for the oscilloscope to be operated after the automatic calibration and diagnosis.

9. HOW TO PHOTOGRAPH THE WAVEFORM

When photographing the scale

Since the oscilloscope is not provided with the scale illumination, the scale cannot be photographed in the normal state. To photograph the scale, perform either of the following methods.

<Raster method>
Connect a 50 kHz sine wave, and set the amplitude of the signal to 8 div on the screen. Set the A TIME/DIV switch to 1 ms and the TRIGGER MODE switch to AUTO. Then the entire screen becomes bright.

<Trace method>
Set the VERTICAL MODE switch to DUAL, the TRIGGER MODE switch to AUTO, and the A TIME/DIV switch to 0.1 ms so that two traces appear.
Increase the brightness of the traces by the INTEN control, and move the two traces to the outside of the screen. Thus the entire screen is brighter than the normal state.

Under the condition that the brightness of the entire screen is increased and the readout display is blanked by the above raster or trace method, photograph the screen first.
Then, display the waveform to be photographed, and photograph the waveform on the same frame with the readout display.

NOTES:

(a) The scale is photographed in black.
(b) When performing the double exposure, fix a camera at the same position to avoid the displacement of the scale and the waveform.

	V-1065A	V-1060	V-665A	V-660
o CRT				
Graticule	6-inch screen with internal graticule 0%, 10%, 90% and 100% markers 8 x 10 DIV (1 DIV = 1cm)	← ← ←	← ← ←	← ← ←
Phosphor	P31	←	←	←
Accelerating potential	17 kV approx.	←	12 kV approx.	←
External intensity modulation	Coupling : DC coupling Voltage : 5 V or more Maximum input voltage : 30 V (DC + AC peak) or 30 Vp-p AC at 1 kHz or less Bandwidth : DC to 5 MHz	← ←	← ←	← ←
o Vertical deflection system				
Sensitivity	2 mV/DIV to 5 V/DIV ±3% (switchable in 11 steps) Continuously variable	← ←	← ←	← ←
Bandwidth	DC to 100 MHz -3dB 2 mV/DIV : DC to 20 MHz -3dB AC low pass : 10 Hz	← ← ←	60 MHz 10 MHz ←	← ← ←
Rise time	3.5 ns approx. 2 mV/DIV : 17.5 ns approx.	← ←	5.9 ns approx. 35 ns approx.	← ←
Delay time	Leading edge can be monitored	←	←	←
Maximum input voltage	400 V (DC + AC peak) at 1 kHz or less	←	←	←
Input coupling	AC, DC, GND	←	←	←
Input impedance	1 M ohms ±1.5%, 23pF ±3pF	←	←	←
Display modes	CH1, CH2, DUAL, CHOP(250 kHz approx.), ADD(DIFF mode can be established when the CH2 is in the INVERT mode.)	←	←	←
Bandwidth limiting function	20 MHz	←	10MHz	←
Polarity selection	± (CH2 only)	←	←	←
Common-mode rejection ratio	20 dB minimum at 20 MHz	←	10 MHz	←

<table>
<tr><th></th><th>V-1065A</th><th>V-1060</th><th>V-665A</th><th>V-660</th></tr>
<tr><td>X-Y operation</td><td>X-axis, Y-axis selectable</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>Sensitivity</td><td>X axis : CH1, CH2 2 mV to 5 V/DIV ±3%
EXT 0.1 V/DIV ±5%
EXT÷10 1 V/DIV ±5%
Y axis : 2 mV to 5 V/DIV ±5%</td><td>←
←
←
←</td><td>←
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←
←</td><td>←
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←</td></tr>
<tr><td>Phase error</td><td>3° or less from DC to 50 kHz</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>X bandwidth</td><td>DC to 500 kHz (-3 dB)</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>o Horizontal deflection system</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Trigger mode</td><td>Trigger, auto trigger</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>Sweep mode</td><td>Main sweep, continuous delay sweep, alternate sweep, single sweep</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>Trigger source</td><td>CH1, CH2, EXT (AC,DC,DC÷10), LINE</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>TV trigger</td><td>Exclusive sync separator circuit provided
Sync polarity: -</td><td>←
←
←</td><td>←
←
←</td><td>←
←
←</td></tr>
<tr><td>Trigger Sensitivity</td><td></td><td></td><td></td><td></td></tr>
<tr><td>NORM mode</td><td><table><tr><th>Frequency</th><th>DC to 20 MHz</th><th>20 MHz to 100 MHz</th></tr><tr><td>INT</td><td>0.35 DIV</td><td>1.5 DIV</td></tr><tr><td>EXT</td><td>50 mV</td><td>150 mV</td></tr></table></td><td>←</td><td>DC to 10 MHz
10 MHz to 60 MHz</td><td>←</td></tr>
<tr><td>AUTO mode</td><td><table><tr><th>Frequency</th><th>30 to 100 Hz</th><th>100 Hz to 20 MHz</th><th>20 to 100 MHz</th></tr><tr><td>INT</td><td>1.5 DIV</td><td>1 DIV</td><td>1.5 DIV</td></tr><tr><td>EXT</td><td>150 mV</td><td>100 mV</td><td>150 mV</td></tr></table></td><td></td><td>30 to 100 Hz
100 Hz to 10 MHz
10 to 60 MHz</td><td></td></tr>
<tr><td>TV mode</td><td>Sync signal
Internal sync : 1 div or more
External sync : 200 mVp-p or more</td><td>←</td><td>←</td><td>←</td></tr>
<tr><td>Trigger level</td><td>Variable range
AUTO: Automatically corresponds to the trigger signal
NORM:
INT : ±4 DIV or more
EXT : ±0.4 V or more
EXT÷10: ±4 V or more</td><td>

←
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←</td></tr>
<tr><td>Slope</td><td>±</td><td>←</td><td>←</td><td>←</td></tr>
</table>

	V-1065A	V-1060	V-665A	V-660
External input impedance	1 M ohms ±5%, 25pF + 6pF	←	←	←
External input voltage	400 V (DC + AC peak) at 1 kHz	←	←	←
Sweep time				
A(main) sweep	50 ns/DIV to 0.5 s/DIV	←	←	←
	Continuously variable (UNCAL)	←	←	←
B(delay) sweep	50 ns/DIV tob 50 ms/DIV	←	←	←
Accuracy	<table><tr><th></th><th>10 to 35°C</th><th>0 to 50°C</th></tr><tr><td>X1</td><td>±3%</td><td>±4%</td></tr><tr><td>MAG X10</td><td>±4%</td><td>±6%</td></tr></table>	←	←	←
Sweep magnification	X10	←	←	←
Maximum sweep rate	5 ns/DIV	←	←	←
Hold off time	Variable	←	←	←
Delay time	1 µs to 5 s	←	←	←
Delay jitter	1/20,000 or less	←	←	←
Alternate separation	Variable	←	←	←
Trigger lock function	Provided	←	←	←
Auto range function	Provided	←	←	←
Single sweep function	Provided	←	←	←
o Readout function				
Panel setting display	Vertical axis : V/DIV (CH1, CH2), UNCAL, probe conversion	Not provided	Same as V-1065A	Not provided
	Sweep speed : S/DIV, UNCAL, MAG (converted value)	←	←	←
	Other : Delay time	←	←	←
o Cursor readout function	Voltage difference ΔV : Δ-REF Time difference ΔT : Δ-REF Frequency 1/ΔT : Δ-REF	No cursor	Same as V-1065A	No cursor
o Frequency counter	Provided	Not provided	Provided	Not provided

	V-1065A	V-1060	V-665A	V-660
o External output				
TRIGGER SIGNAL OUT	Output voltage : 25 mV/DIV approx. (Full scale on the CRT) 50-ohm termination Frequency response: DC to 10 MHz Output impedance : 50 ohms approx.	Not provided	Same as V-1065	Not provided
o Calibrator				
Waveform	1 kHz ±20%, square wave	←	←	←
Voltage	0.5 V ±1%	←	←	←
o Power supply	90 V to 250 V AC, 48 to 65Hz, 40 W approx.	←	←	←
o Others				
Dimensions	275(W) x 130(H) x 360(D) mm approx. (10.8(W) x 5.1(H) x 14.2(D) in. approx.)	←	←	←
Weight	6 kg approx. (13.2 lb. approx.)	←	←	←
Ambient temperature	Operating : 0 to 50 °C (32 to 122 °F) Safe operating : 10 to 35 °C (50 to 95°F) Storage : -20 to 70°C (-4 to 158°F)	← ← ←	← ← ←	← ← ←
Humidity	Operating mode : 35 to 85% Non-operating mode : 45 to 85%	← ←	← ←	← ←
EMI	VDE0871, Category B	←	←	←

Frequency counter (V-1065A, V-665A only)

Measuring signal: Measure the signal selected as a trigger signal by the TRIG SOURCE OR X switch.

Measuring range: 50 Hz to 100 MHz (V-1065A)
50 Hz to 60 MHz (V-665A)

Accuracy of reference signal: 100 ppM (15 to 35°C)

Measuring range	Display format	Resolution	Accuracy
50 Hz < f < 100 Hz	99.99 Hz	0.01 Hz	Ref. signal ±1 LSD
100 Hz ≦ f < 1 kHz	999.9 Hz	1.0 Hz Max	
1 kHz ≦ f < 10 kHz	9.999 kHz	0.002 kHz Max	
10 kHz ≦ f < 100 kHz	99.99 kHz	0.04 kHz Max	
100 kHz ≦ f < 1 MHz	999.9 kHz	0.1 kHz	
1 MHz ≦ f < 10 MHz	9.999 kHz	0.002 MHz Max	
10 MHz ≦ f < 100 MHz: V-1065A 10 MHz ≦ f < 60 MHz: V-665A	99.99 MHz: V-1065A 59.99 MHz: V-665A	0.01 MHz	
100 MHz ≦ f: V-1065A 60 MHz ≦ f: V-665A		Not specified	

HITACHI DENSHI, LTD.
23-2, Kanda Suda-cho 1-chome, Chiyoda-ku, Tokyo 101, Japan
Phone : (03) 3255-8411, Telex : J24178

HITACHI DENSHI AMERICA, LTD.*

Headquarters and New York Office
150 Crossways Park Drive, Woodbury, New York 11797, U. S. A.
Phone : (516) 921-7200, FAX : 516-496-3718, Telex : 510-221-1899

Chicago Office
250 East Devon Ave., Suite 115 Itasca, Illinois 60143, U. S. A.
Phone : (312) 250-8050 FAX : 213-250-8054

Los Angeles Office
371 Van Ness Way, Suite 120 Torrance, California 90501, U. S. A.
Phone : (310) 328-6116, FAX : 310-328-6252

Dallas Office
5910 North Central Expressway Suite 1000, Dallas, Texas 75234, U. S. A.
Phone : (214) 891-6381, FAX : 214-891-6382

Atlanta Office
3039 Amwiler Road, Suite 118 Atlanta, Georgia 30360, U. S. A
Phone : (404) 242-3636, FAX : 404-263-8838

HITACHI DENSHI, LTD. (CANADA)*

Head Office
65 Melford Drive, Scarborough, Ontario M1B 2G6, Canada
Phone : (416) 299-5900, FAX : (416) 299-0450, Telex : 652-5324

Eastern Office
8096 Trans-Canadienne, St-Laurent, Quebec H4S 1M5, Canada
Phone : (514) 332-6687, FAX : (514) 335-1664, Telex : 582-4768

Ottawa Office
9 Antares Drive, Nepean, Ontario K2E 7V5, Canada
Phone : (613) 727-3930, FAX : (613) 727-3950, Telex : 053-4533

HITACHI DENSHI (EUROPA) GmbH*

Head Office
Weiskircher Straße 88, D-6054 Rodgau 1 (Jügesheim),F. R. Garmany
Phone : (06106) 6992-0, FAX : (06106) 16906, Telex : 417-849

HITACHI DENSHI (U. K.) LTD.*

Head Office
13/14 Garrick Industrial Centre, Irving Way, Hendon , London NW9 6AQ,
United Kingdom
Phone : (81) 202-4311, FAX :01-202-2451, Telex : 27449

Leeds Office
Video House , 55 Manor Road, Leeds, LS11, 5PZ, United Kingdom
Phone : 0532-430294, FAX : 0532-459263

* Subsidiaries of Hitachi Denshi, Ltd.

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